REMARKS

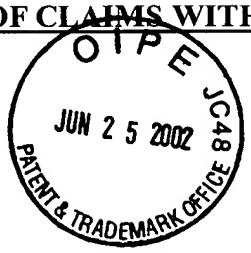
The Examiner has rejected all pending claims pursuant to 35 USC § 103. Namely, the Examiner has stated that all pending claims are unpatentable over Burwen (U.S. Pat. No. 3,184,349) in view of Dullberg (U.S. Pat. No. 3,185,600) and Akram (U.S. Pat. Pub. 2001/0035577). However, as indicated below, all pending claims have been amended and are not unpatentable in light of any of the indicated references whether viewed alone or in combination with one another.

All pending claims have been amended to claim a heat sink material, or the forming thereof, which includes a change in "grain" character or a "re-crystallizing" of the material. In the current action, the Examiner does not indicate the examination of any particular pending claims. However, the Examiner does indicate that Burwen references "heating and cryogenic cooling" generally as applied to certain materials such as aluminum. According to the Examiner, Dullberg similarly discloses cryogenic cooling. The Examiner also states that Akram discloses "heat sink structures and materials" including aluminum. However, none of the cited references makes any mention of material grain size or re-crystallization as now claimed. Therefore, removal of rejections pursuant to 35 USC § 103, is respectfully requested.

Conclusion

For the reasons noted above, applicants respectfully submit that claims 2, 3, 5, 6, 9-11, 13, 16-20, 22, and 24-28 are in condition for allowance. Additionally, authorization is hereby given to credit any overpayment or to charge any deficiencies in connection with this communication to Deposit Account No. 02-2666.

VERSION OF CLAIMS WITH MARKINGS TO SHOW CHANGES MADE



1. (Canceled)

2. (Twice Amended) The [process]method of Claim [1]26 wherein the material is[1 further comprising fabricating the heat sink from] a metal alloy having precipitating constituents.

3. (Twice Amended) The [process]method of Claim [1]26 further comprising affixing the heat sink to a [microelectronic package including a]die[affixed to a carrier substrate].

4. (Canceled)

5. (Amended) The [process]method of Claim [1]26 further comprising[1 wherein the treating of the heat sink to the cryogenic quenching process includes] gradually lowering a temperature of the heat sink to an intermediate[a cryogenic] temperature prior to said subjecting[and then immediately raising the temperature of the heat sink].

6. (Amended) The [process]method of Claim [4]26 wherein the heating reduces a[changing of the microstructure of the heat sink from a fine grain to a coarse grain improves the thermal conductivity of the heat sink by reducing the] number of grain boundaries of the material[in the heat sink that obstruct the movement of atomic and molecular species].

7. (Canceled)

8. (Canceled)

9. (Amended) The [process]method of Claim [8]28 wherein the [metal]alloy material has precipitating constituents.

10. (Amended) The [process]method of Claim [8]28 wherein said re-crystallizing increases a grain size of the alloy material[the thermal conductivity of the heat sink is improved by changing the microstructure of the metal alloy from a fine grain structure to a coarse grain structure].

11. (Twice Amended) The [process]method of Claim [8]28 wherein the alloy material is one of [further comprising fabricating the heat sink from]an aluminum alloy and a copper alloy.

12. (Canceled)

13. (Amended) The [process]method of Claim [8]28 further comprising affixing the heat sink to a[microelectronic] die[mounted to a package substrate].

14. (Canceled)

15. (Canceled)

16. (Amended) The [process]method of Claim [15]27 further comprising [treating the heat sink to a cryogenic quenching process by]gradually lowering a temperature of the heat sink to an intermediate[a cryogenic] temperature prior to said subjecting[and then immediately raising the temperature].

17. (Twice Amended) The [process]method of Claim [14]27 further comprising affixing the heat sink to a [microelectronic package which includes a]die[affixed to a package substrate, the thermal conductivity of the heat sink improved by reducing the grain boundaries that obstruct the movement of atomic and molecular species].

18. (Amended) A method[process for enhancing the thermal conductivity of a heat sink for thermally coupling to a semiconductor die] comprising:

[raising a temperature of the heat sink to an elevated temperature high enough to change]changing a microstructure of a [the heat sink]material of a heat sink from a fine grain to a coarse grain by heating the material to an elevated temperature; and

lowering the temperature of the heat sink to a cryogenic temperature.

19. (Amended) The [process]method of claim 18, further comprising [rapidly]raising the temperature of the heat sink from the cryogenic temperature to a room temperature.

20. (Amended) The method[process] of claim 18, wherein said lowering further[the temperature of the heat sink to a cryogenic temperature] comprises [gradually lowering]initially reducing the temperature of the heat sink to an intermediate temperature above the cryogenic temperature[prior to rapidly lowering the temperature of the heat sink from the intermediate temperature to the cryogenic temperature].

21. (Canceled)

22. (Amended) The [process]method of claim [19]18, further comprising thermally coupling the heat sink to[the semiconductor] a die.

23. (Canceled)

24. (Amended) The [process]method of claim 19, wherein the elevated temperature is greater than 850 degrees Fahrenheit and the cryogenic temperature is approximately -327 degrees Fahrenheit.

25. (Amended) The [process]method of claim 20, wherein [rapidly]said lowering[the temperature of the heat sink to the cryogenic temperature] comprises placing the heat sink in a bath of liquid nitrogen.

26. (New) A method comprising:

providing a heat sink of a material having a grain size increased by heating of the material to improve thermal conductivity of the heat sink; and

subjecting the heat sink to a cryogenic temperature to strengthen the material.

27. (New) A method comprising:

providing a heat sink for coupling to a die, the heat sink of a material having a first grain size; and

increasing the first grain size to a second grain size to enhance the thermal conductivity of the heat sink.

28. (New) A method comprising:

re-crystallizing an alloy material of a heat sink to improve a thermal conductivity of the heat sink; and

subjecting the heat sink to a cryogenic temperature to strengthen the alloy material.

The Examiner is invited to telephone the undersigned to help expedite any further prosecution of the present application.

Respectfully submitted,

BLAKELY SOKOLOFF TAYLOR & ZAFMAN LLP

Date: 6/20, 2002

William F. Ryann
Reg. No. 444,313

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025-1030
Telephone (512) 330-0844
Facsimile (512) 330-0476